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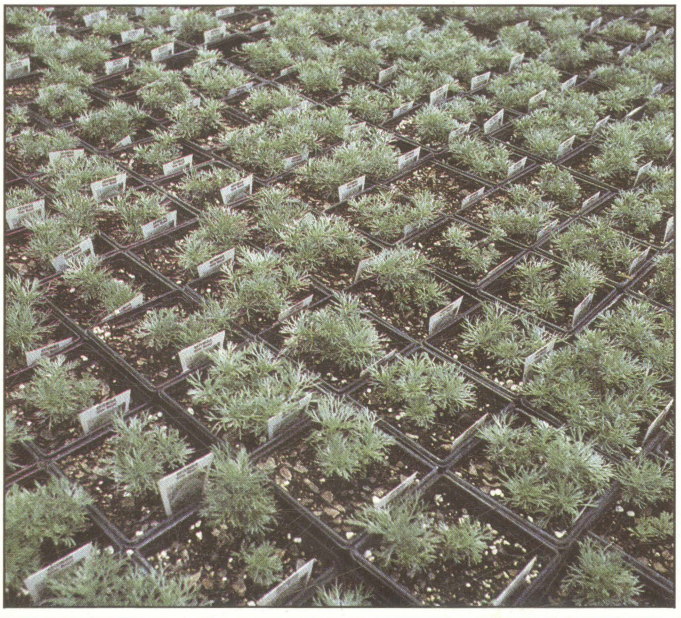
Requirements and Costs of Establishing and Operating a Three-Acre Herbaceous Perennial Container Nursery



The Ohio State University
Ohio Agricultural Research and Development Center
Wooster, Ohio

On The Cover: Perennials can be propagated by several methods including seed and division, then grown in greenhouses or outdoors until they are marketable size.

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Requirements and Costs of Establishing and Operating a Three-Acre Herbaceous Perennial Container Nursery

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Preface

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State Experiment Station personnel contributing to this report included: Reed D. Taylor and Elton M. Smith, Ohio; and David J. Beattie, Pennsylvania.

Abstract

The objective of this study was to identify the resources and costs associated with a herbaceous three-acre perennial nursery. Calculations were based on 1989 prices. Five groups of container-grown plants, differentiated by cultural requirements were delineated. Grouping was based on the combination of method of propagation with length of production cycle. GROUPS I-III are predominantly marketed in one-quart containers and are differentiated on the basis of propagation method: Group I plants are seed-propagated, Group II plants are cutting propagated, Group III plants are propagated from crown divisions. GROUP IV: Garden chrysanthemums, from purchased rooted cuttings, are predominantly marketed in 3-quart containers. GROUP V: Herbs, seed-propagated or cutting propagated, are predominantly sold as 16 plants/flat.

Total costs per salable plant in one-quart containers were: $1.17 for group I plants, $1.24 for group II plants and $1.49 for group III plants. For mums, in three-quart containers, these costs were $1.95. For herbs, grown 16 plants per flat, they were $1.00.

Fixed costs as a percent of total plant costs were: 51 percent for group I, 48 percent for group II, 39 percent for group III, 44 percent for group IV, and 54 percent for group V. For all groups they averaged 49 percent.

Cost differences among groups were caused primarily by cost of propagation materials, space and overwintering requirements, and length of the production cycle.

Key Words: Container-grown perennials, cost of production estimates, plant groups, economic engineering

Agricultural Experiment Stations of Alabama, Arkansas, Connecticut, Delaware, Florida, Georgia, Illinois, Kentucky, Louisiana, Mississippi, New Jersey, New Mexico, Nevada, New York, Ohio, Oregon, Pennsylvania, South Carolina, Tennessee, Texas, in addition to TVA and USDA, cooperating

Requirements and Costs of Establishing and Operating a Three-Acre Herbaceous Perennial Container Nursery

Reed D. Taylor, Elton M. Smith, David J. Beattie and George P. Pealer[1]

Introduction

To make more informed decisions as to whether to enter, leave, or expand herbaceous perennial container production, nurserymen require production, marketing and financial information. Competition in the industry make it imperative that nurserymen have current and systematically determined production costs. In this paper, cost models for producing five categories of container-grown perennials are developed. Physical coefficients are included so the information can be readily updated and so nurserymen can use the models as standards for comparison. The information should provide a basis for decision-making for those evaluating the profitability of establishing a new perennial container nursery, or expanding an existing one.

Production cost models have been developed in USDA Plant Hardiness Zones 5, 6, 7, and 8 for several species of woody ornamental plants (2,3,4,5,6,7,9,10,11, 12,13,14,15,16). Most of these models, while providing excellent information for individual species, did not attempt to develop comprehensive models for complete nursery operating units. Taylor, et al, developed a comprehensive model for container-grown crops representing five categories of container-grown production schemes and two sizes of nurseries applicable to Plant Hardiness Zone 6 (15). Perry, et al, developed a similar study for Plant Hardiness Zones 7 and 8 (13). Comprehensive models were also completed for field production (2 and 16). The procedures and data for each of these studies was useful and complementary to this study.

Objectives

Container-grown herbaceous perennial plants were grouped into five categories based on differences in cultural requirements and length of production. The general objective of this study was to determine the resources and costs associated with producing each of the respective five groups of plants on a model three-acre nursery.

Specific objectives were to:

1. Model a series of production systems that would accommodate a majority of the herbaceous perennial species being grown in Plant Hardiness Zones 5 and 6.
2. Analyze the important species of herbaceous perennials commonly grown in containers in USDA Plant Hardiness Zones 5 and 6, and assign each of them to one of five designated groups based on similarities of growing and production requirements.
3. Design physical facilities including land areas, land improvements, irrigation systems, buildings, machine and equipment components for the nursery based on the model production systems.

Materials and Methods

The basic goals in designing the production facilities (see Figures 1 and 2) were to minimize labor expenses, efficiently move plant material and equipment, maximize the number of salable plants, and allow future expansion. The model nursery was three acres in size with 1.18 acres of growing space and 1.82 acres of buildings, other production facilities, and roads. The conceptual framework of economic engineering wherein the "best proven practice" was incorporated resulting in a model that was based on practices for USDA Plant Hardiness Zones 5-6 in the North Central Region of the U.S. When specific information was required (i.e. depth of the well), specifications were based on the Columbus, Ohio area.

The complete model includes: 1) Characterizing the enterprise mix and appropriate production cycles. 2) Schematic drawings and complete sequence of nursery operational steps, and lists of equipment and other items. 3) Identification and budgets of fixed and variable production costs. Data for this study were obtained from wholesale nurseries and nursery suppliers in the North Central region during the Spring of 1989.

1. Enterprise Mix

We assumed the model nursery would produce a diverse line of herbaceous perennials. Commonly grown perennial plants were divided into five groups based on cultural requirements and production time. While not all inclusive, the groups do permit a range of per unit costs to be developed as they relate to input costs and cultural factors. The five groups with some of their cultural characteristics are listed below.

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Figure 1. Schematic Drawing of a Three-Acre Perennial Container Nursery.

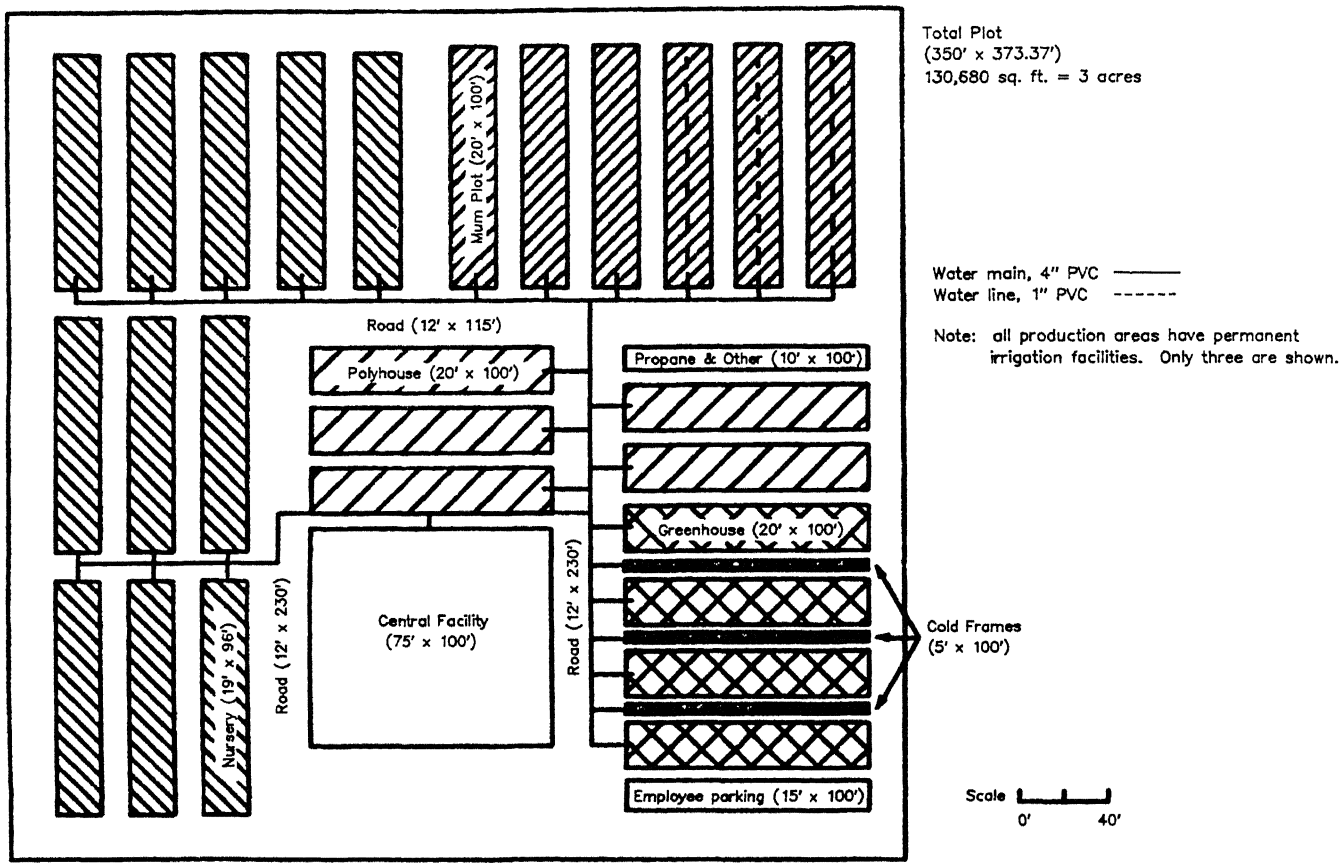
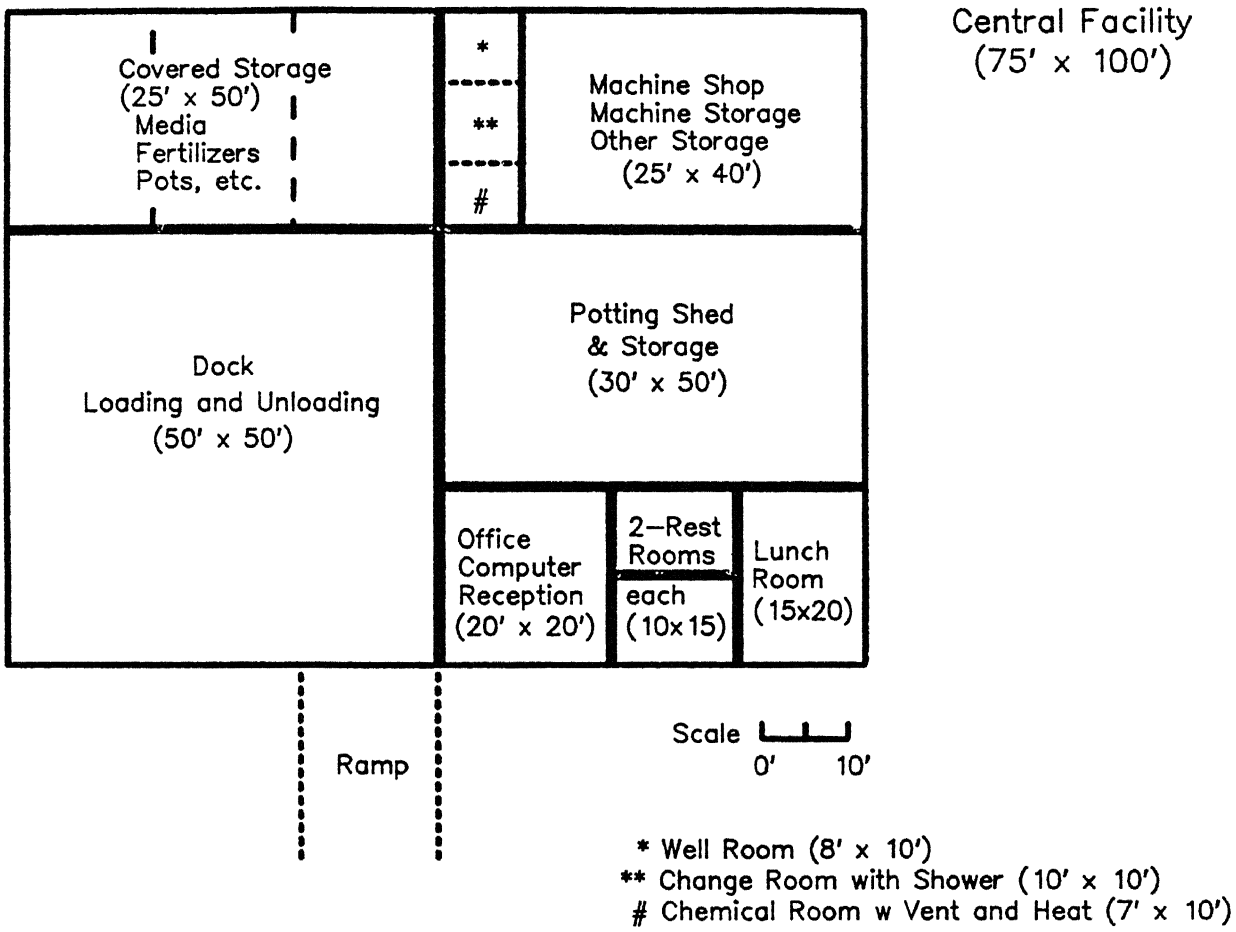


Figure 2. Schematic Drawing of a Three-Acre Perennial Container Nursery's Central Facility.



Group	Plant	Cultural Characteristics
I	**Seed Propagated**	Planted from seed in May.
	(May Propagation)	Propagated in plug trays (#200's).
	Armeria maritima	Shifted to shaded poly-house—two weeks before potting.
	Rudbeckia 'Goldsturm'	Overwintered in structure-less units.
	Aguilegia 'McKana's Hybrids'	
	Coreopsis 'Baby Sun'	
	Lychnis chalcedonica	
	(August-October Propagation)	Seed planted in October in plug trays (#200's).
	Primrose 'Pacific Giant Hybrids'	All plants sold the following spring.
	Lupine 'Russells Mix'	Grown to salable size in heated polyhouses, then moved to unheated poly-houses to harden off.
	Delphinium 'Connecticut Yankee'	
	Gaillardia 'Goblin'	
	Iberis sempervirens	
II.	**Cutting Propagated**	Cuttings taken from stock plants in the spring and other times when needed.
	Monarda 'Cambridge Scarlet'	Rooted in either #98 or #200 plug trays.
	Coreopsis 'Golden Showers'	Commercial medium (ProGro 200).
	Sedum 'Autumn Joy'	Misted until cuttings root, then hardened off.
	Thymus 'Citriodorus'	When well rooted, transplanted into one-quart containers (about six-weeks after sticking).
	Achillea 'Red Beauty'	Overwintered in structure-less system.
III.	**Propagated by Division**	Field-grown plants received bare root.
	Large Divisions	Large divisions planted directly into one gallon containers in June.
	Hosta 'Albo-marginata'	Placed directly into polyhouses grown and overwintered
	Dicentra spectabilis	Sold the following spring.
	Artemesia 'Silver Mound'	
	Brunnera macrophylla	
	Astilbe 'Fanal'	
	Small Divisions	Placed into #72 plug trays.
	Astilbe 'Fanal'	Put into prop house under mist until rooted.
	Geranium 'Wargrave Pink'	After well rooted transplanted into quart containers and placed into heated polyhouses.
	Polemonium 'Blue Pearl'	When saleable, moved to unheated polyhouse for overwintering.
	Viola odorata 'Royal Robe'	
IV.	**Garden Chrysanthemums**	Purchased rooted cuttings. Planted into three-quart containers.
		Grow in mum area until sold.
		Medium—ProGro 300.
		Pinched twice plus corrective pruning.
		Sold in the fall—No overwintering.

(Continued on next page)

(continued)

Group	Plant	Cultural Characteristics
V.	**Herbs—Seed w/transplant** Basil English Thyme Winter Savory Catnip Munstead Lavender	Seed sown by hand into #200 plug trays. Medium—ProGro 200. Transplanted into #16 trays Placed into heated polyhouse until salable size. Shifted to unheated polyhouse for hardening off, then sold.
	Herbs—Direct Seed Coriander Anise Curled Parsley Chives Dill	Seeded directly into sale-sized containers #16 trays (they don't transplant well). Placed into heated polyhouse until salable size. Shifted to unheated polyhouse for hardening off, then sold.
	Herbs—Cuttings Greek Oregano French Lavender Spearmint 'Kentucky Colonel' French Tarragon Rosemary	Fall-cuttings from stock plants rooted in #98 plug trays. Plants potted into Nutray 16's. Grown in heated polyhouse until salable size, then moved to unheated polyhouse to harden off.

2. Physical Plant and Equipment and Development Sequences

Assumptions

Assumptions about the physical facilities and equipment can greatly affect imputed cost as well as the cost per salable plant. The authors attempted to include all items a nursery would typically require. Thus the physical facility is probably more elaborate than that of many nurseries. A nurseryman can easily eliminate or reduce some items. However, the analysis would require substantial effort to do if the items were not included.

The model nursery was designed (Figures 1 and 2) for future expansion and includes plans for a centrally located shipping and "order assembly" area. Thus, expansion can occur with a minimum of disruption. If growing space were enlarged, the central area could be easily expanded without affecting "permanent" facilities. Specific components for the nursery are itemized in Table 1.

Some assumptions that add to a "stripped down" facility are:

Site. It was assumed that land modifications and a well would be required. Land modification costs could be reduced if the nursery had good natural drainage. Locating near a river, lake, or pond could reduce or eliminate the need for a well.

Machinery and Equipment. Purchase of new machinery and equipment was assumed for the model nurseries to reflect realistic replacement costs. Many nurserymen, however, may choose to buy used equipment, rent equipment or time-share some expensive items with other nurseries.

Components

Land Modification (Table 2). To fully utilize the production area, extensive grading, graveling, surface and underground drainage tiles were provided (Table 2). This area would be graded to allow a gradual slope from the central facility to lower points on the edges to utilize a buried 8-inch drain tile. The complete facility planned was to be tiled with 4" plastic tile, 30' on center, 30" deep using a herringbone design. To reduce potential erosion due to irrigation and rainfall the total area was assumed to be graveled 6-inches deep with #8 gravel. In areas where heavy equipment would be used (roadways, shipping area, and parking), a 2-inch deep top dressing of 46D stone was included. Although the graveling costs would be high, they would be offset by more efficient and dependable plant handling, ability to quickly reenter the production areas after natural or artificial irrigation, and reduced soil erosion.

Central facility (Table 3). The nursery was assumed to be supplied with a permanent 3,750 square foot building (50'×75'), It includes an office, computer and reception-room (20'×20'), two rest-rooms with showers (each 10'×15'), a lunch-room (15'×20'), potting-shed with storage (30'×50'), machine-shop with storage (25'×40'), a room for the well (8'×10'), a change-room with heat and a shower for those using chemicals (10'×10'), and a room with heat and ventilation for chemicals (7'×10'). The office, rest-rooms, and lunch-room would be heated, air conditioned, and properly finished. The entire building would be insulated. The potting-shed and machine-shop would be furnished with overhead heaters. Contiguous with the building is a

concrete slab (50′×75′). At the rear of the slab is an area (25′×50′) for bulk and/or other materials, divided into three bins (each with internal dimensions of about 16.3′×24.5′) This bin (25′×50′) area is covered with a 16' high roof. The front portion of the concrete slab (50′×50′) is used for unloading, order assembly, and loading. A dugout ramp where a semi-truck can back in level with the concrete slab to load and unload is also provided.

Some nurseries might either elect or be required to provide a separate small building for chemical storage, clothes changing, and clean up after using chemicals. This would facilitate fire fighting if needed, and possibly enhance worker safety.

Overwintering (growing facilities) (Tables 4 and 5). Overwintering facilities would be of three types, 1) structureless, 2) unheated polyhouses, and 3) heated polyhouses.

Eleven (19′×96′) structure-less units were provided (total=20,064 sq ft). Each unit contains 1,000 (11″×21″) flats or 12,000 quart containers. Each flat contains 12 quart containers. They are placed 10 flats wide (lengthwise) and l00 flats long (width wise). Total capacity of the structure-less units is 132,000 one-quart containers. During the winter, plants in these structure-less units are protected by thermal blankets covered by one layer of white polyethylene.

Five (20′×100′) unheated polyhouses were provided (total=10,000 sq ft) These structures are larger than the traditional 14′×96′ polyhouse, but allow greater head room and are more accessable to machinery. Construction cost per sq ft is essentially the same as for smaller structures. The polyhouses are covered by an inflated double layer of polyethylene; the outer layer is white and the inner layer clear. Plants are further protected by being covered with a thermal blanket.

Three (20′×100′) heated polyhouses were provided. They are covered by an inflated double layer of clear (three-year) polyethylene. Rolling benches were provided to improve both work and heating efficiency. The temperature, during the winter, is maintained at a minimum of 45 degrees fahrenheit.

Cold Frames (Table 6). Three (5′×100′) cold frames would be provided (total 1,500 sq. ft). These are used to harden off plants before being transferred either to a polyhouse or to a structureless unit.

Propagation house (Table 5). One (20′×100′) polyhouse was assumed for propagation (total=2,000 sq. ft.). It would also be used for some growing when space is available. The polyhouse is covered by an inflated double layer of clear (three-year) polyethylene. Plants are propagated in benches heated from below and maintained at a minimum of 55 degrees fahrenheit. An intermittent misting system is provided.

Irrigation system (Tables 7 and 8). Irrigation systems were designed to minimize labor efforts and reduce plant loss, yet provide sufficient irrigation capacity to meet present and future water needs. A basic irrigation system is composed of four parts: 1) water source, 2) pumping equipment, 3) inground irrigation pipe, and 4) above ground irrigation pipe and materials.

The water source must have adequate reserves to meet maximum water needs and sufficient purity to meet cultural requirements. Because municipal water is expensive, especially if the production site is located far from a population center; a well would be desirable. Before drilling the well, the irrigation requirements of the nursery should be estimated so that the diameter of the well will be large enough to accommodate the correct pump size. Once the well has been drilled, and it is estimated that adequate water has been found, a pump test should be performed so the specific capacity of the well can be determined. Results of the pump test which determines the discharge per foot of draw-down is useful in determining the depth of the pump placement. Our model assumes an adequate water source would be found approximately 60 feet below ground. The well was dug to a depth of 80 feet to ensure adequate recharging capacity. In some areas wells would have to be drilled to much greater depths which would result in higher costs.

To properly design a comprehensive irrigation system, the following must be considered: 1) water pressure requirements of the sprinkler heads, 2) water pressure loss due to pipe and valve friction, 3) area to be irrigated at one time, and 4) potential future expansion.

Selection of a well pump is crucial to the nursery operation. As a basic guideline, the maximum pressure loss from entrance point to the farthest point of irrigation within a lateral should be under 20 percent of the pounds per square inch (psi) reading as found at the pump. This assures a constant rate of application from all sprinkler heads on the line. The second guideline is that the combined amount of water exiting the sprinklers at one irrigation setting must be less than the total flow of water coming from the pump. A 20 HP electric pump was selected to drive the water from an 80 foot deep well (Table 8). An electric motor was chosen because of reliability of performance, low maintenance cost and close availability of electrical power. In addition, a right angled gear drive was added to the pump so a tractor could power the pump in case of a power failure.

The third part of the irrigation system is the inground irrigation pipe. The three major advantages of inground water mains are: 1) labor costs for pipe movement is eliminated, 2) breakage due to equipment running over above ground pipe is eliminated, and 3) initial cost of P.V.C. pipe compared to portable above ground aluminum is lower. The inground system would be installed below the frost line (between 4 and 5 feet deep). As seen from Figure 1, 4″ P.V.C. pipe forms major laterals.

The fourth part of the irrigation system would be above ground and would include frost free hydrants. Rotating, sprinklers were provided for dispersing water in the structureless areas and rotating sprinklers were used in the polyhouses.

3. Production Cost Budgets

The enterprise, production cycles and facilities have been described (Tables 1-8 and 10-11, appendices A-E). In this section production budgets will be calculated for

the five plant groups (Tables 19-20) based on the calculated annual fixed costs (Table 9) and estimated variable costs for each plant group (Tables 13-18). This allows us to make costs comparisons among the five respective plant groups.

Most nurseries use cash rather than accrual accounting procedures. For this reason, the analyses were completed on a "cash" basis. One problem with cash accounting is taking into account the start-up period (i.e. the period from when costs are first incurred until salable plants are ready). This paper did not attempt to assess costs or alternative actions for this period.

Fixed Costs

Annual fixed costs are presented in Table 9. These costs were grouped into five categories: 1) land and land improvements; 2) buildings; 3) machinery and equipment; 4) general overhead; and 5) interest on general overhead, insurance and taxes.

Annual fixed costs for land and land improvements, buildings, and machinery and equipment were composed of depreciation, interest, insurance, and taxes. Depreciation was calculated by dividing initial cost adjusted for salvage value by the years of useful life. Interest costs for land were estimated at 12 percent of the original cost of the land. For land improvements it was estimated by taking 12 percent of the average value based on initial costs. For buildings, machinery, and equipment it was estimated by taking 12 percent of the average value based on initial cost and salvage value. It was calculated as ((initial value plus salvage value/2)×.12). Taxes and insurance costs were based on rates prevailing in the rural areas adjacent to Columbus, Ohio. Land, land improvements, and buildings were assessed taxes at the rate of $20 per $1,000 of market value. Insurance was set at $4.46 per $1,000 of market value for buildings and $3.78 per $1,000 of initial value for equipment. Costs for general overhead were determined on a current basis. Interest charges for general overhead, insurance, and taxes were computed for a six-month average use period at a rate of 12 percent per annum.

General Overhead. Cost items not described in detail elsewhere, but which make up a substantial portion of annual fixed costs are placed here. These costs can be classified as follows: utilities, licenses and bonds, advertising and printing, insurance for personnel, travel and professional fees, administrative, management, and clerical salaries and supplies, and miscellaneous. Utilities include heat, electricity and telephone services. It does not include fuel for equipment or machinery. Licenses and bonds are made up of expenses for inspection and certification to sell plants. General maintenance and repairs includes those expenses of maintaining roads and minor repairs to buildings which cannot be capitalized plus maintenance of grounds such as grass cutting and litter pickup. Advertising and printing involve procurement of letterhead items, nursery signs, employee handbooks, want ads for employment, and nursery price lists. Insurance for personnel includes workmen's compensation, FICA, health insurance, plus unemployment insurance for administration and management personnel (hourly laborers costs are included in hourly rates). Travel is made up of expenses to extension workshops, state, regional and national meetings. Professional fees include membership costs of national, state, and local nursery associations. Administration and management are made up of salaries or wages of clerical personnel, management and supervisory personnel, miscellaneous insurance, and office supplies. Miscellaneous includes replacement of office equipment not depreciable plus unexpected costs.

Owner/operators often do not consider their own management/labor or value of owned capital as costs of production. In economic terms production assets supplied by owner/operators, are often referred to as 'opportunity costs' or the income these factors could have earned if they were invested elsewhere. For example, owners could be employed as managers at other nurseries, and money invested in land, buildings, irrigation systems, and equipment could have earned interest in financial institutions. In this study, for complete and comparative analyses, costs were established for all factors of production including management and invested capital.

To determine annual fixed costs per cultural group, total annual fixed costs were divided by the estimated percent of resources used by the cultural group: 25 percent for seed propagated, 25 percent for cuttings propagated, 12 percent for crown divisions, 8 percent for mums, and 30 percent for herbs. Annual fixed costs per salable plant were then determined by dividing the annual number of salable plants in each group into the annual fixed costs allocated to that group.

Variable Costs

Variable costs include all costs that vary with the quantity of plants being grown at one point in time. For example, the number of plants required for crown divisions for planting depends upon the quantity of plants management desires to have in inventory plus production losses.

Variable costs were subdivided into the following categories: propagation, materials, machinery and equipment, labor, and interest on operating capital. These costs were determined for the complete nursery and for each group of plants (Tables 13 thru 18).

Propagation. Propagation costs included seed, cuttings, plants for crown division, rooting media, plug trays, labor for collecting, stripping and sticking, maintenance, harvesting, and for hormone powder.

Containers. Container cost was the price of the containers plus freight which was estimated at 10 percent.

Seed. Estimated at the delivered price.

Plants for crown division. The major cost is the purchase price. While price is somewhat dependent upon quality and quantity, it was assumed that sufficient quantity would be ordered to obtain them at the lowest

possible cost. The second cost was for packing and shipping the plants from producer to purchaser. This was estimated at 10 percent of the purchase price, in each group of plants.

Polyethylene film. Clear, UV treated polyethylene (three-year life) is used for heated polyhouses. Clear polyethylene (4-mil) is used for the inner layer in all unheated polyhouses. White translucent film (4-mil) is used for the outer layer on unheated polyhouses. Black polyethylene (6-mil) is placed under the pots in the mum area.

Thermal blankets. Thermal blankets were provided for overwintering in the structure-less units and in the unheated polyhouses. It was anticipated that the thermal blankets would be used for three seasons. A nursery could reduce costs in this category if it could use the thermal blankets for additional seasons. Costs were based upon the delivered price.

Labels. Labels were provided for identifying plants by botanical name, common name, state plant was grown in, and nursery producer. Costs include printing and shipping charges.

Potting mixture. Many different growing media are used by nursery producers. While materials budgeted here would provide a good medium for the plants under consideration, many producers may prefer different media. The mix budgeted was commercially available (ProGro 300).

Chemicals. Chemical costs were subdivided into two categories, fertilizers and pesticidies. Several types of fertilizer are used. Osmocote (14-14-14) is placed directly into sale-sized containers (quart or three-quart). One-teaspoon is used per quart pot and one-tablespoon per three-quart mum container. The osmocote is moisture and temperature regulated release. After the osmocote is used up, and prior to shipping, plants are fed with a 10-10-10 liquid fertilizer (Plant Marvel). Herbs are fertilized with a 15-16-17 fertilizer (Peter's). Plants are fed about every 10 days in greenhouses and after orders are pulled, but before shipping. Fertilizer prices included delivery to the nursery. Pesticides, insecticides and fungicides are the second category of chemical costs. In the polyhouses, TALSTAR (miticide and aphicide) is used at a rate of 1-oz. per 10 gallon. BENLATE (fungicide) is mixed in with the insecticide at a rate of 16-oz. per 100 gallons. It takes about 50 gallon to cover the entire heated polyhouse area. Plants are sprayed every 7-14 days depending on need. Resmethrin (aerosol) is also used when needed. Safer's insecticidal soap is used on herbs. In the structure-less units, during summer, Sevin wettable power (insecticide) is used at a rate of 2 lb. per 100 gallons. Approximately 60 gallon is used for all 11 structure-less units. Purchase price reflects total cost for the chemicals at local establishments.

Rodent bait. Rodent bait (HAVOC) is placed under the thermal blankets to control mice and other rodents during overwintering.

Machinery and equipment. Variable machinery and equipment costs represent all costs incurred while equipment or machinery is in use. These costs are comprised of repair, fuel and lubrication/filter (Table 12). Repair cost per hour was calculated by multiplying initial cost by a stated repair percentage divided by the estimated lifetime use of the machinery in hours. Fuel costs were determined by multiplying units of fuel used per hour by the price per unit. Filter/lubrication cost was estimated at a constant factor of 15 percent of calculated fuel cost. Summation of repair, fuel and filter/lubrication costs result in total variable cost per hour of machinery or equipment usage.

Propane. Approximately 10,000 gallons of propane are used annually to heat the central facilities, heated polyhouses and propagation house.

Hourly labor. The hourly basic wage was estimated at an average of $5.25 ($4.00 to start rising to $6.50 with experience). An additional 32 percent or $1.68 was allocated for various fringe benefits making a total hourly labor cost of $6.93. Each major production activity was allocated necessary labor hours to accomplish assigned tasks (Note: hours do not include time spent by administration, management or clerical personnel). Hourly labor needs are as follows (Table 10):

Month[1]	Number	Hours
February	4	640
March	4	736
April	11[2]	1,360
May	11[2]	1,496
June	4	704
July	4	640
August	4	736
September	4	640
October	4	704
Total		7,656

[1]During November, December, and January, only the three full time administrative/management employees are on the payroll (owner = $30,000, propagator = $20,000, and production manager $20,000).

[2]Five of the 11 employees employed during April and May are part-time.

Cost Summaries

After all cost factors were determined, they were summarized based upon cost per salable plant by group.

Results and Discussion

Capital Investment Requirements

Capital investment requirements for establishing the nursery were itemized under three broad divisions: land and improvements, buildings, and machinery and equipment (Table 1). Each was further divided into several components. The nursery required $328,923 in investment. Land and land improvements represented 21 percent or $69,183 of the investment, buildings 49 percent or $161,358 and machinery and equipment 30 percent or $98,382.

Land improvement costs were about 85 percent of the cost of unimproved land. Land improvement costs would be necessary in 'typical' USDA Plant Hardiness Zones 5 and 6 to provide drainage and to provide good access to plants in times of inclement weather (Table 2). Building needs included an office/computer/reception layout, two rest-rooms with showers, a lunch-room, a potting-room with storage, a machine-shop for repairs and storage, a chemical-room, a change-room with shower, a well-room, a bulk goods storage area, a dock, a truck ramp, and polyhouse space for propagation, growing, and overwintering (Tables 3 thru 6.) Details for the irrigation system including the pump and well are found in Tables 7 and 8.

Individual nurseries could, of course, incur somewhat different costs than those presented. Individual costs would depend upon variables such as production cycle chosen, labor productivity and ability to bargain with suppliers. The nurseryman also may choose not to provide for future expansion, choose land that would require minimum drainage modifications, reduce optimal growing/overwintering space requirements, rent land and/or equipment, and/or operate used equipment. This analysis assumed average soil conditions, expansion capacity, optimal spacing configurations, new buildings, equipment and machinery.

Production Costs

Fixed Costs

Annual fixed costs associated with capital including depreciation, interest, and taxes were $48,487 per year. In addition $117,250 was allocated for general overhead and $7,377 was allocated for interest on general overhead, insurance and taxes. Annual fixed costs for the three-acre nursery totalled $173,114 (Table 9). The division of costs were based on nursery resources used by the five plant groups and assigned as follows: Group I—25 percent, Group II—25 percent, Group III—12 percent, Group IV—8 percent, and Group V—30 percent. Fixed costs were: $43,277 for Group I (propagated from seed), $43,277 for Group II (propagated from cuttings), $20,773 for Group III (propagated from crown divisions) $13,849 for Group IV (mums), and $51,933 for Group V (Herbs) (Table 19).

On a per-salable-plant basis, there were considerable differences in annual fixed costs among plant groups (Table 20). They were $0.60 for plants propagated from seed, $0.60 for plants propagated from cuttings, $0.58 for plants propagated from crown divisions, $0.87 for mums, and $0.54 for herbs. Fixed costs as a percentage of total costs ranged from 39 percent to 54 percent and averaged 49 percent for the five groups (Table 20).

While many nurserymen and others concerned with the industry might feel that the reported fixed cost figures ranging from 39 percent to 54 percent of total costs might be high, these percentages are in line with those for similar industries with new facilities. Brumfield et. al. (8) in a synthesized analyses of overhead costs of greenhouse firms found fixed (overhead) costs as a percent of sales to range from about 45 percent to over 67 percent depending on size of firm and market channel. The values of this study are not directly comparable with Brumfield et. al. (percent of total costs versus percent of sales). However, if marketing costs and potential profit were taken into account so that a direct comparison could be made, the fixed costs from the Brumfield study would be comparable to those in these analyses. Recent studies on woody plant nurseries, however, did show somewhat lower fixed costs as a percentage of total costs.

Taylor, et. al., (15) in a study of container operations in USDA Plant Hardiness Zone 6 found fixed (overhead) costs as a percent of total costs to range from 37 percent to 51 percent depending on size of firm and number of salable plants. Perry, et. al., (13), for USDA Plant Hardiness Zones 7 and 8, showed fixed costs ranging from 38 percent to 48 percent of total costs in a 16-acre container nursery. Most of the difference between the studies could be accounted for by differences in budgeting.

Nurserymen having established facilities might well consider annual fixed costs to be lower than those reported here. This is especially true if they calculate depreciation and repairs on the original value of land improvements, buildings, machinery and equipment and if they place a low value on their own management input. Good management for planning purposes, however, dictates computing depreciation and repairs on the current value of facilities and equipment rather than on original cost. It also dictates placing a value on managerial time that would be comparable to salaries paid in competitive firms.

Variable Costs

Total variable costs are presented in Table 13. Variable costs differentiated by plant group are detailed in Tables 14 through 18. There were substantial differences between plant groups.

Total variable costs for the three-acre nursery were $40,973 for Group I plants (propagated from seed—Table 14), $46,240 for Group II (propagated from cuttings Table 15), $32,939 for Group III (propagated from crown divisions—Table 16), $17,412 for Group IV (mums—Table 17), and $43,750 for Group V (herbs—Table 18). Total for all groups was $181,274 (Table 13). On a per-salable-plant basis, variable costs were $0.57 for Group I, $0.64 for Group II, $0.91 for Group III, $1.09 for Group IV, and $0.46 for Group V and averaged $0.62 for all groups (Table 20). Variable cost for the nursery ranged from 46 percent to 61 percent of total costs and averaged 51 percent for all groups (Table 20).

Total Costs

Total costs are the summation of fixed and variable costs. They were $84,251 for Group I (propagated from seed), $89,517 for Group II (propagated from cuttings), $53,712 for Group III (propagated from crown divisions), $31,262 for Group IV (mums), and $95,682 for Group V

(herbs). For all groups they totaled $354,424 (Table 19). On a per-salable-plant basis they were $1.17 for Group I, $1.24 for Group II, $1.49 for Group III, $1.95 for Group IV, and $1.00 for Group V and averaged $1.21 for all groups (Table 20).

Summary and Implications

Total costs per salable plant in the three-acre herbaceous perennial container nursery differentiated by plant group ranged from $1.00 to $1.95, and averaged $1.21 for all groups.

Fixed costs per salable plant ranged from $0.54 to $0.87 and averaged $0.59. Fixed costs as a percentage of total costs ranged from 39 percent to 54 percent and averaged 49 percent for all groups. Major differences among species affecting variable costs were: method of propagation, spacing, seed cost, cuttings, plants for crown divisions and labor for harvesting. Variable costs as a percentage of total costs ranged from 46 percent to 61 percent and averaged 51 percent.

Explicit costs are those that are paid directly and are easily determined, e.g. cost of seed, cuttings, plants, potting media, polyethylene, chemicals, labor, etc. Implicit costs are those that are more difficult to determine, such as the cost of equity capital and implied managerial salaries. The way these costs are determined varies significantly from firm to firm. Well-established nurseries are usually very accurate in determining explicit costs, but often do not consider all implicit costs. They base their costs on "cash flow" and profit and loss on "tax accounting." These established nurseries may have purchased land at low cost, be working with depreciated equipment and may be assigning little if any value to their management; in this case determined costs would be at a much lower level than presented in this paper. Also, as pointed out earlier, careful site selection could significantly reduce fixed (overhead) costs.

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Table 1. Capital Requirements for a Three-Acre[1] Perennial Container Nursery, 1989.

Item	Description[2]	Unit	Useful Life (yr)	Quantity	Cost per Unit ($)	Total Cost ($)	Percent of Total Cost[3]
Land							
Unimproved land	Flat, near a metropolitan area	acre	—	3	12,500	37,500	11
Improvements	Clearing, grading, drainage, graveling	acre	20	3	10,561	31,683	10
Subtotal (land)						69,183	21
Buildings							
Building (50′x75′)	50′x75′	each	20	1	100,000	100,000	30
Dock (loading & unloading)	50′x75′ (includes covered bulk bins, truck ramp	each	20	1	15,450	15,450	5
Polyhouses (unheated)	(20′x100′)	each	10	5	1,997	9,985	3
Polyhouses (heated)	(20′x100′)	each	10	4	8,644	34,576	11
Cold Frames	(5′x100′)	each	10	3	449	1,347	0
Subtotal (buildings)						161,358	49
Machinery and equipment							
Office equipment	Computers, copiers, furniture, etc	system	5	1	9,000	9,000	3
Water system	Wells and pumps	system	20	1	27,780	27,780	8
Irrigation	Complete (other than misting)	system	20	1	8,752	8,752	3
Propagation house misting system	Mist-a-matic & plumbing	system	2	1	1,050	1,050	0
Municipal water hook-up (backup)	Materials and fees	system	20	1	2,000	2,000	1
Tractor, 23HP	Ford 1600	each	10	1	9,000	9,000	3
	Front end loader	each	10	1	2,000	2,000	1
Tractor, 16HP	Ford, lawn type	each	10	1	2,500	2,500	1
	Mower, 48″	each	10	1	300	300	0
Flatbed wagons	Each (8′x16′)	each	10	5	600	3,000	1
Sprayer	300-gal.; 10′ boom	each	10	1	1,500	1,500	0
Standby generator	7500 watt	each	10	1	2,500	2,500	1
Delivery truck, stretch van	Holds 150 flats	each	10	1	12,000	12,000	4
Delivery truck, 15′ parcel van	Holds 400 flats	each	10	1	15,000	15,000	5
Miscellaneous	Fert. injector, pallets, hand tools	system	5	1	2,000	2,000	1
Subtotal (machinery & equipment)						98,382	30
Total						328,923	100

[1]Total nursery 3-acres (130,620 sq. ft.) with 1.2 acres growing space (51,560 sq. ft.) and 1.8 acres (79,060 sq. ft.) in production facilities, roads, etc.
[2]For details on individual items, see the following tables: land improvements-Table 2; central facilities-Table 3: polyhouse construction-Table 4; heated polyhouse construction-Table 5; coldframe construction-Table 6; overall irrigation system-Table 7; electric pump & well-Table 8.
[3]Zeros represent less than one-half of 1%. Numbers do not always add due to computer rounding.

Table 2. Land Improvement Costs for a Three-Acre Perennial Container Nursery, 1989.

Item	Description	Unit	Useful Life (yr)	Quantity	Cost per Unit ($)	Total Cost ($)	Percentage of Total Cost
Land grading	Grading including cutting and filling, 900 cu. yd. per acre @$2.00 per cu. yd.	acres	20	3	1,800.00	$5,400	17
(Water Drainage)							
Perimeter pipe	8″ PVC pipe @ $3.80/ft, Installation @ $3.75/ft	foot	20	700	7.55	$5,285	16
Tiling	4″ plastic tile, 30′ on center, herringbone design, 42″ depth	acre	20	3	800.00	$2,400	8
Subtotal (drainage)						7,685	24
Gravel and stone							
Graveling	6″ depth, #8 gravel= 2,420 cu. yds.	cu. yd.	20	2420	7.40	$17,908	56
Stone	2″ depth, 46D stone on roadways, parking lot, front of central facility,=18,412 sq. ft. @ 2″ depth=114 cu. yds.	cu. yd.	20	114	6.05	$690	2
Subtotal (gravel & stone)						18,598	58
Total						31,683	100

Table 3. Requirements, Materials, and Costs for the Central Facilities of a Three-Acre Perennial Nursery, 1989.

Item	Description	Unit	Useful Life (yr)	Quantity	Cost per Unit ($)	Total Cost ($)	Percent of Total Cost[1]
Building							
Shell	Steel pole (50′× 75′), 16′ high Office area (20′×20′) 2 Restrooms (10′×15′) Lunch room (15′×20′) Potting shed (30′×50′) 2(12′×12′) overhead door Machine shop (25′×40′) 1 (12′×12′) overhead door Well (8′×10′) Change room w. shower (10′×10′) Chemical room (locked) (7′×10′) Total 17(3′×6′) doors	sq. ft.	20	3,750	20.00	75,000	65
Improvements	Office, restrooms, lunchroom, change room, chemical room, well room	sq.ft.	20	1,250	20.00	25,000	22
Subtotal (building)						100,000	87
Dock & bulk goods							
Concrete slab	(50′× 75′=) 3750 sq. ft. 6″ depth	cu. yd.	20	70	50.00	3,500	3
	Labor=cost of concrete					3,500	3
Dock Access	Sunken ramp for semi-trucks					1,000	1
Roof over bulk goods	Metal, 16′ high	sq. ft.	20	1,250	3.00	3,750	3
Wall around 3-sides of outside storage area plus two (25′×10′) dividers	Concrete (150′×10′x8″)	cu. yd.	20	37	50.00	1,850	2
	Labor=Cost of concrete					1,850	2
Subtotal (dock & bulk goods area)						15,450	13
Total						115,450	100

Table 4. Materials and Costs for Unheated Polyhouse Construction for a Three-Acre Perennial Container Nursery, 1989.

Item	Description	Unit	Useful Life (yr)	Quantity	Cost per Unit ($)	Total Cost ($)	Percent of Total Cost[1]
Framework (per polyhouse)	20′×100′						
Galvanized steel pipe arches	(3/4″×32′) @ $0.57/ft.	item	10	25	18.24	456	23
Ground inserts	(1″× 4′2″) @ $0.75/ft.	item	10	50	3.15	158	8
Threaded ridge line	(3/4″×100′) @ $0.57/ft	item	10	1	57.00	57	3
End braces	(3/4″×32′) @ $0.57/ft.	item	10	4	18.24	73	4
Subtotal (framework)						743	37
Hardware (per polyhouse)							
Bolts (connecting arches & ground inserts)	(3/4″×3″)	item	10	50	0.12	6	0
Hinges	3″ rustproof	item	10	6	1.20	7	0
Door latch	rustproof	item	10	2	4.00	8	0
Extrusions (double spline)	Tie-down plastic on ends	ft	10	64	1.85	118	6
Extrusions (Male/female)	Tie-down plastic on sides	ft	10	192	1.85	355	18
Inflation kit	Complete	item	10	1	50.00	50	3
Subtotal (hardware)						545	27
Wood	Treated white pine						
(1 1/4″×8″)	Rough cut	ft	10	220	0.74	163	8
(2″×4″×8′)	Rough cut	item	10	4	3.31	13	1
(2″×4″×12′)	Rough cut	item	10	4	4.96	20	1
(1″×6″×8′)	Rough cut	item	10	4	2.60	10	1
(1″×6″×12′)	Rough cut	item	10	4	3.95	16	1
(2″×2″×8′)	Finished	item	10	5	2.14	11	1
Subtotal (wood)						233	12
Labor	Unskilled	hour	10	60	6.93	416	21
Miscellaneous	Tie-down materials, furring strips, plastic tape, treated grain, etc.[2]					60	3
Total (per polyhouse)						1,997	100
Total (5-polyhouses)						9,984	

[1]Zeros represent less than ½ of 1% Numbers do not always add exactly due to computer rounding
[2]Polyethylene film coverings are treated as a variable cost See Tables 13, 14, 15, 16, and 18

Table 5. Materials and Costs for Heated Polyhouse Construction for a Three-Acre Perennial Nuresery, 1989.

Item	Description	Unit	Useful Life (yr)	Quantity	Cost per Unit ($)	Total Cost ($)	Percent of Total Cost[2]
Basic unheated polyhouse[1]	(20'x100')	each	10	1	1997.00	1,997	23
Additional costs for heating eq.							
Gas fired unit heater, Dayton	125,000 BTU	each	10	1	470.00	470	5
Thermostat	Two stage	each	10	1	50.00	50	1
Fan jet+shutter	Acme 18"	each	10	1	560.00	560	6
Set-up for propane[3]	Vent,reg.,etc.	each	10	1	110.00	110	1
Set-up for heating system	Plywood, braces, bolts, etc.	each	10	1	115.00	115	1
Additional labor	Unskilled	hr	10	50	6.93	347	4
Subtotal (heating equipment)						1,652	19
Rolling benches	85% of polyhouse sq. footage	ft	10	1700	2.35	3,995	46
Electrical system	Materials and labor	each	10	1	1000.00	1,000	12
Total (per heated polyhouse)						8,644	100
Total (4-heated polyhouses)						34,574	

[1]For details, see Table 4.
[2]Zeros represent less than ½ of 1%. Numbers do not always add exactly due to computer rounding.
[3]Propane tanks, connectors, etc. will be leased from the company supplying propane.

Table 6. Materials and Costs for Coldframe Construction for a Three-Acre Perennial Container Nursery, 1989.

Item	Description	Unit	Useful Life (yr)	Quantity	Cost per Unit ($)	Total Cost ($)	Percent of Total Cost
-Per Coldframe-							
Wood	Treated white pine						
Framework (2"x12")	Rough cut	ft	10	210	1.25	263	59
Cross ties (1"x2"x5')	Rough cut	Item	10	20	1.00	20	4
Subtotal (wood)						283	63
Hardware							
End braces	12"	Item	10	8	1.00	8	2
Braces between boards	12"	Item	10	16	1.00	16	4
Screws	1 1/2" (100/box)	Box	10	1	3.50	4	1
Subtotal (hardware)						28	6
Labor	Unskilled	hr	10	20	6.93	139	31
Total (per coldframe)						449	100
Total (3-coldframes)						1,346	

Table 7. Cost of an Irrigation System for a Three-Acre Perennial Container Nursery, 1989.

Item	Description	Unit	Cost Per Unit (dollars)	Quantity Needed	Total Cost (dollars)
Inground mainline					
4″ Pipe	PVC	foot	1.33	1,040	1,383
Additional required equipment	Estimated at 20% of pipe value				277
Installation charges		foot	1.40	1,040	1,456
Subtotal (inground mainline)					3,116
Structureless areas	Per area				
11-Perennial areas (20′×96′)	1-frost free hydrant 1″				
6-Mum areas (20′×100′)	@ $60.00, 85 ft of 1″ PVC				
3-Cold frames (5′×100′)	pipe @$0.24/foot=$20.40,				
	5-sprinkler risers 3/4″×8′				
	@ $14=$70.00,				
	installation labor/parts				
	estimated at 30% of pipe				
	cost (PVC & risers)=$27.12				
	5-Rotating sprinklers,				
	#30BH Rainbird, nozzle size				
	5/32″×3/32″@$10.50=$52.50	area	230.02	20	4,600
Polyhouse structures	Per polyhouse (20′×100′)				
5-unheated	1-frost free hydrant				
4-heated	@ $60.00, 85 ft of 1 PVC				
	pipe @ $0.24/foot=$20.40,				
	5-sprinkler drops				
	1″×18″ @ $.036=$1.80				
	installation labor/parts				
	estimated at 30% of pipe				
	cost=$6.67, 5-rotating				
	sprinklers, Nelson Whizhead				
	5/64″ nozzels @ $5.25=$26.25	polyhouse	115.12	9	1,036
Misting system (propagation house)	Mist-a-matic	each	250	3	750
	Pipes and nozzels				300
Subtotal (misting system)					1,050
Municipal	Hookup and fees				2,000
TOTAL					11,802

Table 8. Specifications and Costs (Dollars) of Installing a 20 H.P. Electric Pump and an 80 Foot Well, 1989.

Specifications	Cost (dollars)
Pump—above ground, lineshaft, 1.800 RPM	
Basic electric motor, 3 phase, 220 volt	1,764
Discharge head—6″×1 collar	1,048
Standard 10′ length, inner column, 80′	2,205
Pipe and suction pipe	375
Pump bowl assembly—9 stage, 8″ pump	2,646
Air line guage	50
Well seal, well plate, cement	386
Electrical equipment	97
Installation fee	1,102
Right angle gear drive, auxillary power source[1] using a tractor	1,554
Pressure tank (water storage under pressure)	2,000
Subtotal	13,227
+Freight @ 10%	1,323
Total cost for pump	14,550
Well Drilling	
Casing diameter, 12″ O.D.	13,230
Total	27,780

[1]A 20 H.P. pump can supply 300 gallons of water per minute at 55 psi given the specifications and site location.

Table 9. Annual Fixed Costs ($) for a Three-Acre[1] Perennial Container Nursery, 1989.

Item	Description	Depreciation[2]	Interest[3]	Insurance and Taxes[4]	Total
Land					
Unimproved land	Flat, near a metropolitan area		4,500	750	5,250
Improvements	Clearing, grading, drainage, graveling	1,426	1,901	634	3,960
Subtotal (land)		1,426	6,401	1,384	9,210
Buildings					
Building (50'x75')	50'x75'	4,500	6,600	2,446	13,546
Dock (loading & unloading)	50'x75' (includes covered bulk bins, truck ramp	695	1,020	378	2,093
Polyhouses (unheated)	(20'x100')	899	659	244	1,802
Polyhouses (heated)	(20'x100')	3,112	2,282	846	6,240
Cold Frames	(5'x100')	121	89	33	243
Subtotal (buildings)		9,327	10,650	3,947	23,923
Machinery and equipment					
Office equipment	Computers, copiers, furniture, etc	1,620	594	34	2,248
Water system	Wells and pumps	1,250	1,833	105	3,189
Irrigation system	Complete	394	578	33	1,005
Propagation house misting system	Misting systems (Mist-a-matic)	473	69	4	546
Municipal water hookup —backup	Hookup (materials and fees)	90	132	8	230
Tractor, 23HP	Ford 1600	810	594	34	1,438
	Front-end loader	180	132	8	320
Tractor, 16HP	Ford, lawn type	225	165	9	399
	Mower, 48"	27	20	1	48
Flatbed wagons	Each (8'x16')	270	198	11	479
Sprayer, boom	300-gal.; 10' boom	135	99	6	240
Standby generator	7500 watt	225	165	9	399
Delivery truck, stretch van	Holds 150 flats	1,080	792	45	1,917
Delivery truck, 15' parcel van	Holds 400 flats	1,350	990	57	2,397
Miscellaneous	Fert. injector, pallets, hand tools	360	132	8	500
Subtotal (machinery & equipment)		8,488	6,493	372	15,354
Total for Depreciation, interest, Insurance and Taxes		19,241	23,544	5,702	48,487
General Overhead					
Utilities	Telephone, electric, gas heat				2,000
Licenses and bonds					400
General repairs and maintenance	Buildings, grounds, roads				1,000
Advertising and printing	Trade shows, catalogs, etc.				1,000
Insurance, personnel[5]	Workmen's compensation, FICA, health, unemployment				24,980
Travel and professional fees					1,000
Administrative and management[6]	Owner/operator, Propagator, Supervisor				85,870
	Clerical, office supplies				
Miscellaneous					1,000
Subtotal					117,250
Interest on General Overhead, Insurance and Taxes	12% per annum for 6 months on a total of $122,875				7,377
Total Annual Fixed Costs					173,114

[1]Total nursery 3 acres (130,620 sq. ft.), with 1.2 acres growing space (51,560 sq. ft.) and 1.8 acres (79,060 sq. ft.) in production facilities, roads, etc.
[2]Depreciation was estimated by dividing initial cost (adjusted for a 10% salvage value) by the years of useful life.
[3]Interest costs for land was estimated by taking 12% of the initial value. For land improvements it was estimated by taking 12% of the average value based on initial value. Interest on buildings, machinery and equipment was estimated by taking 12% of the average value based on initial cost and salvage value. It was calculated as ((initial value plus salvage value/2)x.12).
[4]Insurance and taxes. Land and improvements-only taxes are assessed, at a rate of $20 per $1,000 of market value.
Buildings-taxes are assessed at a rate of $20 per $1,000 of market value. Insurance, $500 deductible, at $4.46 per $1,000 of market value. Total for category=$24.46 per $1,000.
Machinery and equipment-taxes are not assessed in Ohio on personal property. Insurance, $500 deductible, at $3.78 per $1,000 of initial value.
[5]Insurance and other fringe benefits were estimated at 32% for owner/operator, propagator, supervisor, and clerical.
[6]Owner operator=$30,000, propagator=$20,000, supervisor=$20,000, clerical-part time (February thru October=1,536 hrs. @$5.25=$8,064). Total for salaries $78,064.
[6]Supplies=10% of salaries or $7,806. Total for category=$85,870.

Table 10. Monthly Labor Requirements (Hours) for a Three-Acre Perennial Container Nursery, 1989.

Type	Month												
	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
Permanent (management)[1]	528	480	552	480	528	528	480	552	480	528	528	480	6,144
Clerical (temporary-full time)[2]	0	160	184	160	176	176	160	184	160	176	0	0	1,536
Temporary-full time[3]	0	640	736	960	1,056	704	640	736	640	704	0	0	6,816
Temporary-1/2 time[4]	0	0	0	400	440	0	0	0	0	0	0	0	840
TOTAL	528	1,280	1,472	2,000	2,200	1,408	1,280	1,472	1,280	1,408	528	480	15,336

[1]Three permanent full-time employees are hired: owner/operator, propagator, and supervisor.
[2]One secretary/clerical person is hired full-time from February thru October.
[3]Four temporary, full-time employees are hired during February and March, and June thru October Six are hired for April and May.
[4]Five temporary-1/2 time employees are hired during April and May.

Table 11. Estimated Planting and Harvesting Requirements for a Three-Acre Perennial Container Nursery, 1989.

Group	Description	Propagation			Transplanted			Sales/Annual			
		Number	Container	%Loss	Number	Container[1]	%Loss	Season	Next Spring	Total	Total
		Cells/flat								Units	Plants
I	Seed	444	200's	10	6,667	flats/12's	10	1000	5000	6000	72000
II	Cuttings	907	98's	10	6,667	flats/12's	10	1000	5000	6000	72000
III	Divisions	617	72's	20	3,333	flats/12's	10	500	2500	3000	36000
IV	Mums	—	—	—	17,778	3-Quart	10	16000	0	16000	16000
V	Herbs	605	98's	10	6,667	flats/16's	10	6000	0	6000	96000
		297	200's	10							

[1]Groups I, II, and III are grown and sold in flats containing 12, 1-quart (4"×4" containers). Group IV plants (mums) are grown and sold in 3-quart containers, and herbs are sold in flats containing 16 cells.

Table 12. Estimated Variable Cost per Hour for Machinery and Equipment for a Three-Acre Perennial Container Nursery, 1989.

Number	Item	New Cost ($)	Expected Life (yr.)	Estimated Annual Use (hr.)	Estimated Cost per Hour of Use			
					Repairs[1] ($)	Operating[2] ($)	Lubrication and Filter ($)	Total
1	Office equipment	9000	5	1000	0.72			0.72
	Water system and irrigation							
2	Water system, well & pump	27,780	20	270	0.51	1.60	0.24	2.35
3	Inground (mainline)	3,116	20	270	0.23			0.23
4	Structure-less areas	4,600	20	270	0.34			0.34
5	Polyhouse structures	1,036	20	270	0.08			0.08
6	Propagation house (additional-misting)	1,050	2	185	1.14			1.14
7	Tractor,23HP	9,000	10	800	0.68	2.50	0.38	3.55
8	Front-end loader	2,000	10	200	0.60			0.60
9	Tractor, 16HP	2,500	10	400	0.38	1.75	0.26	2.39
10	Mower, 48"	300	10	100	0.18			0.18
11	Flatbed wagons (ea)	600	10	600	0.04			0.04
12	Sprayer, boom	1500	10	60	2.00			2.00
14	Delivery truck, stretch van,¾ ton	12000	10	375	1.92	6.25	0.94	9.11
15	Delivery truck, 15' parcel van	15000	10	375	2.40	8.34	1.25	11.99
Total								

[1]Repairs per hour were based on percent of new cost over the life of the asset. Percent factors used were: 10 for item number 2; 40 for numbers 1,3,4,5,6, and 11; 60 for items 7,8,9,10,13, and 14: 80 for item 12. The total was then divided by the estimated total number of hours the equipment would be used over its total life (i.e. the well & pump would be used 5,400 hours over a 20 year period).
[2]Operating cost was estimated at 8 cents per pump hoursepower per hour. A 20 horse power pump would therefore cost $1.60 per hour for electricity and lubrication, gasoline for the tractor and trucks was estimated at $1.25 per gallon, and 15% of the cost of gasoline was allocated for lubrication and filters. It was estimated that each truck would travel 15,000 miles per year on company business. It was further estimated that they would average 40 miles per hour in delivery work. This would require 375 hours of operation for each vehicle. The stretch van would use 5 gallons of fuel per hour at a cost of $6.25, and the parcel van would use 6.67 gallons per hour at a cost of $8.34.

Table 13. Variable Costs (Dollars) for Three-Acre[1] Perennial Container Nursery, 1989.

Item	Description	Unit	Cost per Unit ($)	Quantity	Total Variable Cost ($)	Percent of Variable Cost[2]
Propagation						
Containers	Plug trays—72's	each	0.66	617.0	407	0
	Plug trays—98's	each	0.66	1,512.0	998	1
	Plug trays—200's (TLC's)	each	0.66	741.0	489	0
Rooting medium	Prepackaged (ProGro 200) 3 cu ft	bag	8.50	116.0	986	1
Seed	Various varieties	oz.	44.83	80.0	3,586	2
Cuttings	From stock plants (non-herbs)	plant	0.07	88,886.0	6,222	3
Plants	For crown divisions	divisions	0.25	50,000.0	12,500	7
Plants	Rooted cuttings (mums)	plants	0.22	17,778.0	3,911	2
Hormone power	Root Tone-F #1	lb	15.00	2.0	30	0
Subtotal (propagation)	Does not include labor				29,130	16
Materials						
Containers						
Mums	3-quart	each	0.14	17,778.0	2,542	1
Seed, Cuttings, Divisions	Nupot/Nutray 12	set	1.18	16,667.0	19,667	11
Herbs	Nupot/Nutray 16	set	1.18	6,667.0	7,867	4
Potting medium	Prepackaged (ProGro 300) 3 cu ft	bag	5.49	3,121.0	17,134	9
Polyethylene film (clear) (4-mil, 1-yr.)	5 (1-sheet ea—5 unheated houses)	ea	65.00	5.0	325	0
Polyethylene film (clear) (6-mil, 3-year material) $226 (32'x125') roll	8 (2-sheets ea—4 heated houses) (Replaced every 3rd year)	ea	226.00	2.7	610	0
Polyethylene film (white)	5 (32'x125')—unheated polyhouses	ea	102.90	5.0	515	0
(1-year material)	11 (24'x100')—Structure-less	ea	61.74	11.0	679	0
Weed barrier (5-year material)	6 mum plots (20'x100') (Replaced every 5th year)	ea	124.00	1.2	149	0
Shade cloth—(5-year)	9—48% (32'x100')=1.8/yr. (Replaced every 5th year)	ea	278.00	1.8	500	0
Thermal blanket (3-year material) $180 (80"x225') roll	11 (20'x100') structureless areas 5 (20'x100') unheated polyhouses Total=16=1.33x22.61/3 yrs.=7.54 (Replaced every 3rd year)	ea	180.00	7.5	1,350	1
Plant name tags	Labels and/or Stik-Stakes	each	0.02	324,450.0	6,489	4
Propane	Heating	gallons	0.65	10,000.0	6,500	4
Electricity	Does not include 7,400 KWH used with the water system pump	KWH	0.06	28,000.0	1,680	1
Chemicals	Plant marvel 20-20-20 (fert)	lb	0.84	215.0	181	0
	Osmocote 14-14-14 (fertilizer)	lb	1.00	3,345.0	3,345	2
	Peter's Liq. 15-16-17 (Herbs)	lb	1.00	40.0	40	0
	Sevin (insecticide)	lb	2.80	12.0	34	0
	Safer's (insect. soap-herbs)	gal	25.00	7.0	175	0
	Daconil (fungicide)	gal	35.00	2.5	88	0
	Benlate (fungicide)	lb	13.00	19.5	255	0
	Resmethryn (aerosol)	lb	6.25	16.0	100	0
	Havoc (rodent bait)	pkg	0.75	175.0	131	0
Subtotal (materials)					70,355	39
Machinery and Equipment	Office equipment	hr	0.72	1,000.0	720	0
	Water system and irrigation					
	Water systems, well & pump	hr	2.35	270.0	635	0
	Inground (mainline)	hr	0.23	270.0	62	0
	Structure-less areas	hr	0.34	270.0	92	0
	Polyhouse structures	hr	0.08	270.0	22	0
	Propagation house (extra)	hr	1.14	180.0	205	0
	Tractor 23HP	hr	3.55	800.0	2,840	2
	front end loader	hr	0.60	200.0	129	0
	Tractor 16HP (Lawn Type)	hr	2.39	400.0	956	1
	48" mower	hr	0.18	100.0	18	0
	Flatbed wagons	hr	0.04	3,000.0	120	0

(Continued on next page)

Table 13. continued

Item	Description	Unit	Cost per Unit ($)	Quantity	Total Variable Cost ($)	Percent of Variable Cost[2]
	Sprayer, boom 11′	hr	2.00	60.0	120	0
	Del. vehicle-Rental	hr	15.50	300.0	4.650	3
	Del. vehicle-Stretch van	hr	9.11	375.0	3.416	2
	Del. vehicle-15′ van	hr	11.99	375.0	4,496	2
	Standby electronic generator	hr				
Subtotal (mach. & Eq.)					18,472	10
Labor (non-permanent)[3]						
	Labor hours	hr	6.93	6,125.0	42,446	23
	Related labor hours, 20%	hr	6.93	1,531.0	10,610	6
Subtotal (labor)					53,056	29
Interest charge on operating capital	Computed at 12% on an annual basis for 6 months	%	6.00 (0.06)		10,261	6
Total variable Costs					181,274	100

[1]Total nursery 3 acres (130,620 sq. ft.), with 1.2 acres growing space (51,560 sq. ft.).
[2]Zeros represent less than one-half of 1%. Numbers do not always add due to computer rounding.
[3]Average basic wage before withholding taxes and fringe benefits= $5.25, taxes and fringe benefits add 32% or $1.68 for a total of $6.93.

Table 14. Variable Costs (Dollars) for Group I Plants (Propagated from Seed) for a Three-Acre[1] Perennial Container Nursery, 1989.

Item	Description	Unit	Cost per Unit ($)	Quantity	Total Variable Cost ($)	Percent of Variable Cost[3]
Propagation						
Containers	Plug trays—200's (TLC's)	each	0.66	444.0	293	1
Rooting medium	Prepackaged (ProGro 200) 3 cu ft	bag	8.50	11.0	94	0
Seed	Purchased	oz.	44.83	40.0	1,793	4
Subtotal (propagation)	Does not include labor				2,180	5
Materials						
Containers	Nupot/Nutray 12	set	1.18	6,667.0	7,867	19
Potting medium	Prepackaged (ProGro 300) 3 cu ft	bag	5.49	834.0	4,579	11
Poly (clear) 1-yr.	27% of total requirement[4]	ea	65.00	1.3	85	0
Poly (clear) 3-yr.	27% of total requirement[4]	ea	226.00	0.7	158	0
Poly (w) (32'x125')	27% of total requirement[4]	ea	102.90	1.3	134	0
Poly (w) (24'x100')	27% of total requirement[4]	ea	61.74	3.0	185	0
Shade cloth—(5-year)	27% of total requirement[4]	ea	278.00	0.5	139	0
Thermal blanket	27% of total requirement[4]	ea	180.00	2.0	360	1
Plant name tags	Labels	ea	0.02	80,000.0	1,600	4
Propane	Heating—27% of total[4]	gallons	0.65	2,700.0	1,755	4
Electricity	27% of total requirement[4]	KWH	0.06	7,560.0	454	1
Chemicals	Plant Marvel 20-20-20 (fert)	lb	0.84	50.0	42	0
	Osmocote 14-14-14 (fertilizer)	lb	1.00	1,062.0	1,062	3
	Sevin (insecticide)	lb	2.80	2.0	6	0
	Daconil (fungicide)	gal	35.00	1.0	35	0
	Benlate (fungicide)	lb	13.00	4.0	52	0
	Havoc (rodent bait)	pkg	0.75	70.0	53	0
Subtotal (materials)					18,564	45
Machinery and equipment	Office equipment-25%[4]	hr	0.72	250.0	180	0
	Water system and irrigation					
	Water system, well & pump-25%[4]	hr	2.35	67.5	159	0
	Inground (mainline)-25%[4]	hr	0.23	67.5	16	0
	Structure-less areas-36%[4]	hr	0.34	97.2	33	0
	Polyhouse structures-27%[4]	hr	0.08	72.9	6	0
	Propagation house (extra)-27%[4]	hr	1.14	48.6	55	0
	Tractor 23HP-25%[4]	hr	3.55	200.0	710	2
	front end loader-25%[4]	hr	0.60	50.0	30	0
	Tractor 16HP (Lawn Type)-25%[4]	hr	2.39	100.0	239	1
	48" mower-25%[4]	hr	0.18	25.0	5	0
	Flatbed wagons-25%[4]	hr	0.04	750.0	30	0
	Sprayer, boom 11'-36%[4]	hr	2.00	21.6	43	0
	Del. vehicle-rental-25%[4]	hr	15.50	75.0	1,163	3
	Del. vehicle—stretch van-25%[4]	hr	9.11	93.8	855	2
	Del. vehicle—15' van-25%[4]	hr	11.99	93.7	1,123	3
	Standby electric generator	hr				
Subtotal (mach. & Eq.)					4,646	11
Labor (non-permanent)[2]	Labor hours-25%[4]	hr	6.93	1,531.3	10,612	26
	Related labour hours,-25%[4]	hr	6.93	382.8	2,653	6
Subtotal (labor)					13,265	32
Interest charge on operating capital	Computed at 12% on an annual basis for 6 months	%	6.00 (0.06)		2,319	6
Total Variable Costs					40,973	100
Variable Cost per salable plant (4 1/4"x4 1/4" container)	Units available for sale	ea		72,000	0.57	
per flat	12-container/flat	flat		6,000	6.83	

[1]Total nursery 3 acres (130,620 sq. ft.), with 1.2 acres growing space (51,560 sq. ft.). Group I plants used approximately 25% of the nurseries resources, including approximately 13,068 sq. ft. of growing space.
In Group I Plants, 88,800 plug cells would be planted in the propagation house and about 10% would be lost, leaving 80,000 plugs for transplanting into quart- containers. About 10% of the plants in quart-containers would be lost, leaving 72,000 salable plants (6,000 flats). 1,000 flats would be sold during the Summer and Fall and 5,000 the following Spring.
[2]Average basic wage before withholding taxes and fringe benefits=$5.25, taxes and fringe benefits add 32% or $1.68 for a total of $6.93.
[3]Zeros represent less than one-half of 1%. Numbers do not always add due to computer rounding.
[4]Variable costs that could not be directly allocated were allocated on the basis of their percentage use of nursery labor. In the case of Group I Plants, this was 25%. In some cases a different percentage was used where there were classes of plants that did not use a particular resource. The percentage figure was 27% where Mums did not use a resource, and 36% where Herbs did not use a resource.

Table 15. Variable Costs (Dollars) for Group II Plants (Propagated from seed) for a Three-Acre[1] Perennial Container Nursery, 1989.

Item	Description	Unit	Cost per Unit ($)	Quantity	Total Variable Cost ($)	Percent of Variable Cost[3]
Propagation						
Containers	Plug trays—98's	each	0.66	907.0	599	1
Rooting medium	Prepackaged (ProGro 200) 3 cu ft	bag	8.50	35.0	298	1
Cuttings	From stock-plants	cutting	0.07	88,886.0	6,222	13
Hormone powder	Root Tone-F #1	lb	15.00	2.0	30	0
Subtotal (propagation)	Does not include labor				7,148	15
Materials						
Containers	Nupot/Nutray 12	set	1.18	6,667.0	7,867	17
Potting medium	Prepackaged (ProGro 300) 3cu ft	bag	5.49	834.0	4,579	10
Poly (clear) 1-yr.	27% of total requirement[4]	ea	65.00	1.3	85	0
Poly (clear) 3-yr.	27% of total requirement[4]	ea	226.00	0.7	158	0
Poly (w) (32'×125')	27% of total requirement[4]	ea	102.90	1.3	134	0
Poly (w) (24'×100')	27% of total requirement[4]	ea	61.74	3.0	185	0
Shade cloth—(5-year)	27% of total requirement[4]	ea	278.00	0.5	139	0
Thermal blanket	27% of total requirement[4]	ea	180.00	2.0	360	1
Plant name tags	Labels	each	0.02	80,000.0	1,600	3
Propane	Heating—27% of total[4]	gallons	0.65	2,700.0	1,755	4
Electricity	27% of total requirement[4]	KWH	0.06	7,560.0	454	1
Chemicals	Plant Marvel 20-20-20 (fert)	lb	0.84	50.0	42	0
	Osmocote 14-14-14 (fertilizer)	lb	1.00	1,062.0	1,062	2
	Sevin (insecticide)	lb	2.80	2.0	6	0
	Daconil (fungicide)	gal	35.00	1.0	35	0
	Benlate (fungicide)	lb	13.00	4.0	52	0
	Havoc (rodent bait)	pkg	0.75	70.0	53	0
Subtotal (materials)					18,564	40
Machinery and equipment	Office equipment-25%[4]	hr	0.72	250.0	180	0
	Water system and irrigation					
	Water system, well & pump-25%[4]	hr	2.35	67.5	159	0
	Inground (mainline)-25%[4]	hr	0.23	67.5	16	0
	Structure-less areas-36%[4]	hr	0.34	97.2	33	0
	Polyhouse structures-27%[4]	hr	0.08	72.9	6	0
	Propagation house (extra)-27%[4]	hr	1.14	48.6	55	0
	Tractor 23HP-27%[4]	hr	3.55	200.0	710	2
	front end loader-25%[4]	hr	0.60	50.0	30	0
	Tractor 16HP (Lawn Type)-25%[4]	hr	2.39	100.0	239	1
	48" mower-25%[4]	hr	0.18	25.0	5	0
	Flatbed wagons-25%[4]	hr	0.04	750.0	30	0
	Sprayer, boom 11'-36%[4]	hr	2.00	21.6	43	0
	Del. vehicle—Rental-25%[4]	hr	15.50	75.0	1,163	3
	Del. vehicle—stretch van-25%[4]	hr	9.11	93.8	855	2
	Del. vehicle—15' van-25%[4]	hr	11.99	93.7	1,123	2
	Standby electric generator	hr				
Subtotal (mach. & Eq.)					4,646	10
Labor (non-permanent)[2]	Labor hours-25%[4]	hr	6.93	1,531.3	10,612	23
	Related labor hours,-25%[4]	hr	6.93	382.8	2,653	6
Subtotal (labor)					13,265	29
Interest charge on operating capital	Computed at 12% on an annual basis for 6 months	%	6.00 (0.06)		2,617	6
Total Variable Costs					46,240	100
Variable Cost per salable plant (4 1/4"×4 1/4" container)	Plants available for sale	ea		72,000.0	0.64	
per flat	12-container/flat	flat		6,000.0	7.71	

[1]Total nursery 3 acres (130,620 sq. ft.), with 1.2 acres growing space (51,560 sq. ft.). Group II plants used approximately 25% of the nurseries resources, including approximately 12,865 sq. ft. of growing space. In Group II Plants, 88,800 plug cells would be planted in the propagation house and about 10% would be lost, leaving 80,000 plugs for transplanting into quart-containers. About 10% of the plants in quart-containers would be lost, leaving 72,000 salable plants (6,000 flats). 1,000 flats would be sold during the Summer and Fall and 5,000 the following Spring.
[2]Average basic wage before withholding taxes and fringe benefits=$5.25, taxes and fringe benefits add 32% or $1.68 for a total of $6.93.
[3]Zeros represent less than one-half of 1%. Numbers do not always add due to computer rounding.
[4]Variable costs that could not be directly allocated were allocated on the basis of their percentage use of nursery labor. In the case of Group II Plants, this was 25%. In some cases a different percentage was used where there were classes of plants that did not use a particular resource. The percentage figure was 27% where Mums did not use a resource, and 36% where Herbs did not use a resource.

Table 16. Variable Costs (Dollars) for Group III Plants (Propagated from Crown Division) for a Three-Acre[1] Perennial Container Nursery, 1989.

Item	Description	Unit	Cost per Unit ($)	Quantity	Total Variable Cost ($)	Percent of Variable Cost[3]
Propagation						
Containers	Plug trays—72's	each	0.66	617.0	407	1
Rooting medium	Prepackaged (ProGro 200) 3 cu ft	bag	8.50	39.0	332	1
Plants	For crown divisions	divisions	0.25	50,000.0	12,500	38
Subtotal (propagation)	Does not include labor				13,239	40
Materials						
Containers	Nupot/Nutray 12	set	1.18	3,333.0	3,933	12
Potting medium	Prepackaged (ProGro 300) 3 cu ft	bag	5.49	417.0	2,289	7
Poly (clear) 1-year	13% of total requirement[4]	ea	65.00	0.7	46	0
Poly (clear) 3-year	13% of total requirement[4]	ea	226.00	0.4	90	0
Poly (w) (32'×125')	13% of total requirement[4]	ea	102.90	0.7	72	0
Poly (w) (24'×)100')	13% of total requirement[4]	ea	61.74	1.4	86	0
Shade cloth—(5-year)	13% of total requirement[4]	ea	278.00	0. 2	56	0
Thermal blanket	13% of total requirement[4]	ea	180.00	1.0	180	1
Plant name tags	Labels	each	0.02	40,000.0	800	2
Propane	Heating—13% of total[4]	gallons	0.65	1,300.0	845	3
Electricity	13% of total requirement[4]	KWH	0.06	3,640.0	218	1
Chemicals	Plant Marvel 20-20-20 (fert)	lb	0.84	25.0	21	0
	Osmocote 14-14-14 (fertilizer)	lb	1.00	531.0	531	2
	Sevin (insecticide)	lb	2.80	1.0	3	0
	Daconil (fungicide)	gal	35.00	0.5	18	0
	Benlate (fungicide)	lb	13.00	2.0	26	0
	Havoc (rodent bait)	pkg	0.75	35.0	26	0
Subtotal (materials)					9,240	28
Machinery and equipment	Office equipment-12%[4]	hr	0.72	120.0	86	0
	Water system and irrigation					
	Water system, well & pump-12%[4]	hr	2.35	32.4	76	0
	Inground (mainline)-12%[4]	hr	0.23	32.4	7	0
	Structure-less areas-17%[4]	hr	0.34	45.9	16	0
	Polyhouse structures-13%[4]	hr	0.08	35.1	3	0
	Propagation house (extra)-13%[4]	hr	1.14	23.4	27	0
	Tractor 23HP-12%[4]	hr	3.55	96.0	341	1
	front end loader-12%[4]	hr	0.60	24.0	14	0
	Tractor 16HP (Lawn Type)-12%[4]	hr	2.39	48.0	115	0
	48" mower-12%[4]	hr	0.18	12.0	2	0
	Flatbed wagons-12%[4]	hr	0.04	360.0	14	0
	Sprayer, boom 11'-17%[4]	hr	2.00	10.2	20	0
	Del. vehicle—Rental-12%[4]	hr	15.50	36.0	558	2
	Del. vehicle—stretch van-12%[4]	hr	9.11	45.0	410	1
	Del. vehicle—15' van-12%[4]	hr	11.99	45.0	540	2
	Standby electric generator	hr				
Subtotal (mach. & Eq.)					2,229	7
Labor (non-permanent)[2]	Labor hours-12%[4]	hr	6.93	735.0	5,094	15
	Related labor hours,-12%[4]	hr	6.93	183.7	1,273	4
Subtotal (labor)					6,367	19
Interest charge on operating capital	Computed at 12% on an annual basis for 6 months	%	6.00 (0.06)		1,864	6
Total Variable Costs					32,939	100
Variable Cost per salable plant (4 1/4" × 4 1/4" container)	Plants available for sale	ea		36,000	0.91	
per flat	12-container/flat	flat		3,000	10.98	

[1]Total nursery 3 acres (130,620 sq. ft.), with 1.2 acres growing space (51,560 sq. ft.). Group III plants used approximately 12% of the nurseries resources, including approximately 6,187 sq. ft. of growing space. In Group III Plants, 50,040 plug cells would be planted in the propagation house and about 20% would be lost, leaving 40,000 plugs for transplanting into quart-containers. About 10% of the plants in quart-containers would be lost, leaving 36,000 salable plants (3,000 flats). 500 flats would be sold during the Summer and Fall and 2,500 the following Spring.
[2]Average basic wage before withholding taxes and fringe benefits=$5.25, taxes and fringe benefits add 32% or $1.68 for a total of $6.93.
[3]Zeros represent less than one-half of 1%. Numbers do not always add due to computer rounding.
[4]Variable costs that could not be directly allocated were allocated on the basis of their percentage use of nursery labor. In the case of Group III Plants, this was 12%. In some cases a different percentage was used where there were classes of plants that did not use a particular resource. The percentage figure was 13% where Mums did not use a resource, and 17% where Herbs did not use a resource.

Table 17. Variable Costs (Dollars) for Group IV Plants (Mums) for a Three-Acre[1] Perennial Container Nursery, 1989.

Item	Description	Unit	Cost per Unit ($)	Quantity	Total Variable Cost ($)	Percent of Variable Cost[3]
Propagation						
Plants	Rooted cuttings	plant	0.22	17,778.0	3,911	22
Subtotal (propagation)	Does not include labor				3,911	22
Materials						
Containers	3-quart	each	0.14	17,778.0	2,542	15
Potting medium	Prepackaged (ProGro 300) 3 cu ft	bag	5.49	523.0	2,871	16
Weed barrier (5-year material)	6 mum plots (20'x100') (Replaced every 5th year)	ea	124.00	1.2	149	1
Plant name tags	Labels	each	0.02	17,778.0	356	2
Chemicals	Plant Marvel 20-20-20 (fert)	lb	0.84	90.0	76	0
	Osmocote 14-14-14 (fertilizer)	lb	1.00	708.0	708	4
	Sevin (insecticide)	lb	2.80	7.0	20	0
	Benlate (fungicide)	lb	15.00	5.6	84	0
Subtotal (materials)					6,805	39
Machinery and Equipment	Office equipment-8%[4]	hr	0.72	80.0	58	0
	Water system and irrigation					
	Water system, well & pump-8%[4]	hr	2.35	21.6	51	0
	Inground (mainline)-8%[4]	hr	0.23	21.6	5	0
	Structure-less areas-11%[4]	hr	0.34	29.7	10	0
	Tractor 23HP-8%[4]	hr	3.55	64.0	227	1
	front end loader-8%[4]	hr	0.60	16.0	10	0
	Tractor 16HP (Lawn Type)-8%[4]	hr	2.39	32.0	76	0
	48"xmower-8%	hr	0.18	8.0	1	0
	Flatbed wagons-8%[4]	hr	0.04	240.0	10	0
	Sprayer, boom 11'-11%[4]	hr	2.00	6.6	13	0
	Del. vehicle—Rental-8%[4]	hr	15.50	24.0	372	2
	Del. vehicle—stretch van-8%[4]	hr	9.11	30.0	273	2
	Del. vehicle—15' van-8%[4]	hr	11.99	30.0	360	2
	Standby electric generator	hr				
Subtotal (mach. & eq.)					1,466	8
Labor (non-permanent)[2]	Labor hours-8%[4]	hr	6.93	490.0	3,396	20
	Related labour hours-8%[4]	hr	6.93	122.5	849	5
Subtotal (labor)					4,245	24
Interest charge on operating capital	Computed at 12% on an annual basis for 6 months	%	6.00 (0.06)		986	6
Total Variable Costs	Total Variable Costs				17,412	100
Variable Cost per salable plant	Plants available for sale	ea		16,000	1.09	

[1]Total nursery 3 acres (130,620 sq. ft.), with 1.2 acres growing space (51,560 sq. ft.). Group IV plants used approximately 8% of the nursery resources, including approximately 4,125 sq. ft. of growing space. In Group IV Plants, 17,778 plants would be planted in 3-quart containers and about 10% would be lost, leaving approximately 16,000 salable plants. These would all be sold during the season.
[2]Average basic wage before withholding taxes and fringe benefits=$5.25, taxes and fringe benefits add 32% or $1.68 for a total of $6.93.
[3]Zeros represent less than one-half of 1%. Numbers do not always add due to computer rounding.
[4]Variable costs that could not be directly allocated were allocated on the basis of their percentage use of nursery labor. In the case of Group IV Plants, this was 8%. In some cases a different percentage was used where there were classes of plants that did not use a particular resource. The percentage figure was 11% where Herbs did not use a resource.

Table 18. Variable Costs (Dollars) for Group V Plants (Herbs) for a Three-Acre[1] Perennial Container Nursery, 1989.

Item	Description	Unit	Cost per Unit ($)	Quantity	Total Variable Cost ($)	Percent of Variable Cost[3]
Propagation						
Containers	Plug trays—98's	each	0.66	605.0	399	1
	Plug trays—200's (TLC)	each	0.66	297.0	196	0
Rooting medium	Prepackaged (ProGro 200) 3 cu ft	bag	8.50	31.0	264	1
Seed	Varieties	oz.	44.83	40.0	1,793	4
Subtotal (propagation)	Does not include labor				2,652	6
Materials						
Containers	Nutray/Nupot 16's	set	1.18	6,667.0	7,867	18
Potting medium	Prepackaged (ProGro 300) 3 cu ft	bag	5.49	513.0	2,816	6
Poly (clear) 1-yr.	33% of total requirement[4]	ea	65.00	1.7	111	0
Poly (clear) 3-yr.	33% of total requirement[4]	ea	226.00	0.9	203	0
Poly (w) (32'×125')	33% of total requirement[4]	ea	102.90	1.7	175	0
Poly (w) (24'×100')	33% of total requirement[4]	ea	61.74	3.7	228	1
Shade cloth—(5-year)	33% of total requirement[4]	ea	278.00	0.6	167	0
Thermal blanket	33% of total requirement[4]	ea	180.00	2.5	450	1
Plant name tags	Labels	each	0.02	106,672.0	2,133	5
Propane	Heating—33% of total[4]	gallons	0.65	3,300.0	2,145	5
Electricity	33% of total requirement[4]	KWH	0.06	9,240.0	554	1
Chemicals	Peter's Liq. 15-16-17 (Herbs)	lb	1.00	40.0	40	0
	Safer's (insecticide soap)	gal	25.00	7.0	175	0
	Benlate (fungicide)	lb	13.00	4.0	52	0
	Resmethryn (aerosol)	lb	6.25	16.0	100	0
Subtotal (materials)					17,217	39
Machinery and equipment	Office equipment-30%[4]	hr	0.72	300.0	216	0
	Water system and irrigation					
	Water system, well & pump-30%[4]	hr	2.35	81.0	190	0
	Inground (mainline)-30%[4]	hr	0.23	81.0	19	0
	Polyhouse structures-33%[4]	hr	0.08	91.8	7	0
	Propagation house (extra)-33%[4]	hr	1.14	61.2	70	0
	Tractor 23HP-30/[4]	hr	3.55	240.0	852	2
	front end loader-30%[4]	hr	0.60	60.0	36	0
	Tractor 16HP (Lawn Type)-30%[4]	hr	2.39	120.0	287	1
	48" mower-30%[4]	hr	0.18	30.0	5	0
	Flatbed wagons-30%[4]	hr	0.04	900.0	36	0
	Del. vehicle—Rental-30%[4]	hr	15.50	90.0	1,395	3
	Del. vehicle—stretch van-30%[4]	hr	9.11	112.5	1,025	2
	Del. vehicle—15' van-30%[4]	hr	11.99	112.5	1,349	3
	Standby electric generator	hr				
Subtotal (mach. & Eq.)					5,487	13
Labor (non-permanent)[2]	Labor hours-30%[4]	hr	6.93	1,837.5	12,734	29
	Related labor hours,-30%[4]	hr	6.93	459.3	3,183	7
Subtotal (labor)					15,917	36
Interest charge on operating capital	Computed at 12% on an annual basis for 6 months	%	6.00 (0.06)		2,476	6
Total Variable Costs					43,750	100
Variable Cost per salable plant	Plants available for sale	ea		96,000	0.46	
per flat	16 cell/flat	flat		6,000	7.29	

[1]Total nursery 3 acres (130,620 sq. ft.), with 1.2 acres growing space (51,560 sq. ft.). Group V plants used approximately 30% of the nurseries resources, including approximately 15,488 sq. ft. of growing space. In Group V Plants, 118,482 plug cells would be planted in the propagation house and about 10% would be lost, leaving 106,634 plugs for transplanting into #16 trays. About 10% of the plants in the trays would be lost, leaving 96,000 salable plants (6,000 flats). All 6,000 flats would be sold during the season.
[2]Average basic wage before withholding taxes and fringe benefits=$5.25, taxes and fringe benefits add 32% or $1.68 for a total of $6.93.
[3]Zeros represent less than one-half of 1%. Numbers do not always add due to computer rounding.
[4]Variable costs that could not be directly allocated were allocated on the basis of their percentage use of nursery labor In the case of Group V Plants, this was 30%. In some cases a different percentage was used where there were classes of plants did not use that particular resource. The percentage figure was 33% where Mums did not use a resource.

Table 19. Summary of Fixed, Variable and Total Costs (Dollars) of Operating a Three-Acre[1] Perennial Container Nursery, 1989.

Description	Group I (Seed)	Group II (Cuttings)	Group III (Divisions)	Group IV (Mums)	Group V (Herbs)	Total
Fixed Costs[2]						
Land and improvements	2,303	2,303	1,105	737	2,763	9,210
Buildings	5,981	5,981	2,871	1,914	7,177	23,923
Machinery and equipment	3,839	3,839	1,842	1,228	4,606	15,354
General overhead	29,313	29,313	14,070	9,380	35,175	117,250
Interest on general overhead, insurance, and taxes	1,843	1,843	885	590	2,212	7,372
Subtotal	43,277	43,277	20,773	13,849	51,933	173,109
Variable Costs						
Propagation	2,180	7,148	13,239	3,911	2,652	29,130
Materials	18,564	18,564	9,240	6,805	17,217	70,390
Machinery and equipment	4,646	4,646	2,229	1,466	5,487	18,474
Labor	13,265	13,265	6,367	4,245	15,917	53,059
Interest on operating capital	2,319	2,617	1,864	986	2,476	10,262
Subtotal	40,974	46,240	32,939	17,413	43,749	181,315
Total	84,251	89,517	53,712	31,262	95,682	354,424
Salable Plants Per Year	72,000	72,000	36,000	16,000	96,000	292,000
Total Cost per Salable Plant	1.17	1.24	1.49	1.95	1.00	1.21

[1]Total nursery 3 acres (130,620 sq ft) with 1 2 acres growing space (51,560 sq ft.) and 1 8 acres (79,060 sq ft.) in production facilities, roads, etc.
[2]Fixed costs were allocated based on the number of hours spent with each group of plants Twenty-three percent of fixed costs allocated to Group I Plants, 23% to Group II Plants, 12% to Group III Plants, 12% to Group IV Plants, and 30% to Group V Plants
[3]Individual figures do not always add to the total due to rounding

Table 20. Summary of Fixed, Variable and Total Costs (Dollars) per Salable Plant for a Three-Acre[1] Perennial Container Nursery, 1989.

Item	Group I (Seed)		Group II (Cuttings)		Group III (Divisions)		Group IV (Mums)		Group V (Herbs)		Total	
	Cost per Salable Plant	Percent of Total Cost	Cost per Salable Plant	Percent of Total Cost	Cost per Salable Plant	Percent of Total Cost	Cost per Salable Plant	Percent of Total Cost	Cost per Salable Plant	Percent of Total Cost	Cost per Salable Plant	Percent of Total Cost
Fixed Costs												
Land and improvements	0.03	(3)	0.03	(3)	0.03	(2)	0.05	(2)	0.03	(3)	0.03	(3)
Buildings	0.08	(7)	0.08	(7)	0.08	(5)	0.12	(6)	0.07	(8)	0.08	(7)
Machinery and equipment	0.05	(5)	0.05	(4)	0.05	(3)	0.08	(4)	0.05	(5)	0.05	(4)
General overhead	0.41	(35)	0.41	(33)	0.39	(26)	0.59	(30)	0.37	(37)	0.40	(33)
Interest on general overhead insurance, and taxes	0.03	(2)	0.03	(2)	0.02	(2)	0.04	(2)	0.02	(2)	0.03	(2)
Subtotal	0.60	(51)	0.60	(48)	0.58	(39)	0.87	(44)	0.54	(54)	0.59	(49)
Variable Costs												
Propagation	0.03	(3)	0.10	(8)	0.37	(25)	0.24	(13)	0.03	(3)	0.10	(8)
Materials	0.26	(22)	0.26	(21)	0.26	(17)	0.43	(22)	0.18	(18)	0.24	(20)
Machinery and equipment	0.06	(6)	0.06	(5)	0.06	(4)	0.09	(5)	0.06	(6)	0.06	(5)
Labor	0.18	(16)	0.18	(15)	0.18	(12)	0.27	(14)	0.17	(17)	0.18	(15)
Interest on operating capital	0.03	(3)	0.04	(3)	0.05	(3)	0.06	(3)	0.03	(3)	0.04	(3)
Subtotal	0.57	(49)	0.64	(52)	0.91	(61)	1.09	(56)	0.46	(46)	0.62	(51)
Total Costs per Salable Plant	1.17	(100)	1.24	(100)	1.49	(100)	1.95	(100)	1.00	(100)	1.21	(100)

[1]Total nursery 3 acres (130,620 sq. ft.) with 1.2 acres growing space (51,560 sq. ft.) and 1.8 acres (79,060 sq. ft.) in production facilities, roads, etc.
[2]Individual figures do not always add to the total due to rounding.

Appendix A

Production Cycle — Propagation from Seed — Group I

May Purchased Seed (About 60 percent of seed)

1. **Planting.** Seeds are immediately planted, by hand, in plug trays (200 TLC's) in propagation house. Time in plug trays will vary from eight to 12 weeks. Typical 12-week plants are Iberis, Teucrium, Aguilegia. Typical 8-week Plants: Shasta Daisy, Lychnis, Coreopsis grandiflora.

2. **Move to Polyhouse.** Approximately two weeks before potting, plants are moved in the plug trays from the propagation house to a polyhouse. Some hardening takes place in the polyhouse. It is more of an outdoor environment, with air movement. Sides of the polyhouse are opened.

3. **Potting.** When plants have sufficient root development to hold the soil ball together in the plug, they are potted into one-quart containers. If space is available in the nursery, they are moved there. Usually they will not be moved again until they are sold.

4. **Fall sales.** A portion of the crop will be ready to be sold by October 1st. Examples are Coreopsis and Shasta Daisy and/or any other plants that have grown sufficiently.

5. **Overwintering.** The majority of the plants will be overwintered (without a polyhouse) under thermal blankets in the nursery.

6. **Spring sales.** The remainder of the crop is sold in the spring.

August and October Purchased Seed

1. **General.** Same procedure as for May purchased seed, except for Fall sales and overwintering.

2. **Overwintering.** Plants will be overwintered in heated polyhouses.

3. **Movement to unheated polyhouses.** In the Spring, when they have grown to salable size, they will be moved to unheated polyhuts.

4. **Spring sales.** All plants are sold.

Appendix B

Production Cycle — Cuttings — Group II

1. **Cuttings.** Cuttings are taken in the spring and at other times depending upon the plant. Sometimes cuttings are taken when plants are potted. This yields very fresh young growth that roots very well. Silver Mound does best when cuttings are taken in a cool period (April and October) and should not be too wet. Lythrum cuttings are normally taken during June and Sedum 'Autumn Joy' in July. All root well.

2. **Propagation.** Use a rooting hormone (ROOTONE-F #1) on most species (Cerostigma and Monarda). No hormone is needed on sedum and yarrow. Stick into "98" plug trays, filled with a commercial plug mix (ProGro 200). Place in propagation house under mist system or hand water. Once rooted, leave in propagation house, but take away from mister. If hot, hand water three to four times daily.

3. **Potting.** When well rooted, pot into one-quart containers filled with ProGro 300. Surface apply one teaspoon of 14-14-14 Osmocote. Potting starts approximately six weeks after sticking. Plant must be large enough to have a root system developed enough to hold the soil ball in the ball together. When potted, put in nursery and water twice a day. Make sure the container is thoroughly moistened.

4. **Overwinter.** Plants are overwintered in nursery (without a polyhouse) under a thermal blanket.

5. **Marketing.** Practically all sales are in the spring.

Appendix C

Production Cycle — Division/Bare Root — Group III

Note: For the sake of simplicity, budgets in this study did not include plants in gallon containers. In reality, most perennial nurseries do sell some plants in gallon containers. Therefore, information on plants grown in gallon containers is in the following production cycle outline.

1. **Procurement.** All divisions are purchased, field grown plants, shipped bareroot. They are purchased in fall, winter, and spring. Fall purchases include true Geraniums and Dicentra. Artemisia 'Silver Mound' and Virginia Bluebells are examples of plants arriving in February and potted in March while Astilbe is an example of a June potted plant.

2. **Division decision.** Some plants are planted whole as received and some are subdivided. The decision to divide or not to divide depends on species, size, and sales strategy. An example would be Astilbe. Buy 500 (three to five eye divisions) in June. Place 300 into gallon containers for sale the following Spring. Remaining 200 would be subdivided (three to five divisions from each) into quart containers. May be able to further subdivide the 200 and obtain 500 quart containers for sale the following spring.

3. **Production.**

   Gallon containers. Used for plants that will not be subdivided. They are planted directly into gallon containers using ProGro 300. They are placed in polyhouses and watered. Irrigation is by hand and takes about 100 gallons per polyhouse. Two-days later they are fertilized using Plant Marvel. They are overwintered in double layered polyhouses under a thermal blanket.

   Quart containers. Used for plants that are subdivided into fairly large segements. On the average, each crown yields about four clumps for production in quart containers. Each clump is planted directly into a one-quart container using a commercial media (ProGro 300). One teaspoon of Osmocote 14-14-14 would be added. Quart pots are placed 12 per flat. A Stik-Stake picture label is placed in each pot. After planting, they are placed in polyhouses and watered. Irrigation is by hand and takes about 100 gallons per polyhouse. They are overwintered in double layered polyhouses under a thermal blanket. Plants potted in November are placed in heated polyhouses where the heat is maintained between 40-45 degrees.

   Plug trays. Small plants and small divisions are first placed into #72 plug trays (Ajuga would be an example of a plant small enough to go into plug trays). Plug trays go into either the propagation house or a heated polyhouse until they are ready to be placed in pots. They are fertilized with Plant Marvel 17-17-17 every one to two weeks depending upon the weather. When well rooted with new green growth showing, they will be placed in pots. After potting, they are placed in a heated polyhouse until well started and then placed into unheated polyhouses for overwintering.

4. **Marketing.** Plants are sold in the spring and throughout the summer.

Appendix D

Production Cycle — Mums — Group IV

1. **Procurement.** Rooted cuttings are purchased. Ball is approximately one-inch in diameter. Top growth is about 2-3″. Cuttings arrive at the end of May.

2. **Planting.** Plants are potted directly into three-quart containers. One plant per pot. Potting starts about the first of June. Add one tablespoon of 14-14-14 Osmocote per pot. A commercial media (ProGro 300) is used. Pots are placed directly into the mum area where they will stay until sold.

3. **Irrigation.** Mums are hand watered right after potting and then irrigated by the overhead irrigation system.

4. **Fertilization.** They are fertilized approximately every two weeks by hand using Plant Marvel (20-20-20). It is mixed at the rate of 300-500 parts per million.

5. **Pinching.** Pinched two weeks after potting (middle of June) by hand. Takes three-man days for 16,000 plants. Second pinch occurs four weeks after potting by hand. Takes nine-man days for 16,000 plants. Corrective pinch takes two-man days. All pinching must be done before July 15 to insure good bud production.

6. **Overwintering.** Mums are not overwintered.

7. **Marketing.** Plants are all sold in the Fall starting in August.

Appendix E

Production Cycle — Herbs — Group V

1. **General.** Propagation is by three methods: seed, direct seed, and cuttings.

2. **Seed.** (Examples: basil, thyme, winter savory, catnip)

   Propagation. Seed is sown by hand into plug trays (200's) filled with a commercial medium (ProGro 200). Trays are placed into the propagation house.

   Fertilize. Fertilize when leaves appear, then weekly until April 1, then twice weekly.

   Potting. Transplant into 3″ square pots, (16 pots per flat) when roots hold rootball and when space in heated polyhouse permits.

3. **Direct Seed.** (Examples: Coriander, Anise, Curled Parsley, Chives, Dill, Lavender mumstead)

   Propagation. Planted directly into sale-sized containers (3″ square pot, 16 pots per flat) because they do not transplant well. Medium used is ProGro 300 in pots and ProGro 200 in plug trays. Normally several seeds are planted per pot or container. With lavender mumstead you can get by with one plant per container, but for most, several are needed. Seeds are sown from March 19 to June 1, depending on production and sales requirements.

   Fertilize. When plants reach seedling size (cotyledon size and before first true leaves) they are fertilized the first time with Peter's 15-16-17. Fertilization continues weekly until April 1, then twice a week until plants are moved to polyhouses. Fertilizer is then reduced to once every 10-14 days.

   Growout. Plants (3″ square pot, 16 pots per flat) are placed in Herb heated polyhouse until large enough to be salable, and then put in a polyhouse to be held and hardened off.

4. **Cuttings.** (Examples: Greek Oregano, French Lavendar, Spearmint 'Kentucky Colonel').

   Propagation. Cuttings are taken from firms stock plants. Results are usually better than from purchased cuttings. Would purchase cuttings for especially large orders, or if propagating a new cultivar. If cuttings are taken in the Fall, stick in 98's plug tray. They will stay in the plug tray longer than spring cuttings and they need a larger sized plug cavity. If cuttings are taken in the spring, stick in 200's.

   Potting. Plants are potted as space permits and in anticipation of marketing demands.

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